

REMARKS

This Amendment is filed in response to the Office Action dated April 22, 2004, which has a shortened statutory period set to expire July 22, 2004.

Applicants greatly appreciate the Examiner's indication of allowed/allowable subject matter. Specifically, Claims 13-17, 22-27, 35-43, and 48-58 are allowed, whereas Claims 7-12 and 29-34 are objected to as being dependent from a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants have rewritten Claims 7 and 29 in independent form including all of the limitations of the base claim and any intervening claims. Therefore, Applicants request reconsideration and withdrawal of the objection to Claims 7 and 29. Claims 8-12 depend from Claim 7 and therefore are patentable for the same reasons as presented for Claim 7. Based on those reasons, Applicants request reconsideration and withdrawal of the objection to Claims 8-12. Claims 30-34 depend from Claim 29 and therefore are patentable for the same reasons as presented for Claim 29. Based on those reasons, Applicants request reconsideration and withdrawal of the objection to Claims 30-34.

Applicants respectfully traverse the rejection of Claims 1-3, 5-6, 18-21, 28, 44-47, and 59-70. Specifically, Claim 1 recites in part:

identifying a first feature proximate to the defect on the simulated wafer image of the physical mask;

identifying a second feature on the simulated wafer image of the reference mask, the second feature corresponding to the first feature; and

computing critical dimension deviations including the first and second features to provide the printability analysis.

Applicants submit that Pang fails to disclose or suggest these limitations. The drawings/passages cited in the Office Action to reject Claim 1 (i.e. Figs. 1, 2, 3, and 10(a), as well as col. 2, lines 28-44, col. 2, line 58 to col. 3, line 18, and col. 20, lines 14-31) do not teach anything regarding identifying a first feature proximate to the defect on the simulated wafer image of the physical mask, identifying the corresponding feature on the simulated wafer image of the reference mask, and computing CD deviations including these features to provide the printability analysis.

Specifically, Figs. 1(a)-(f) illustrate examples of typical photolithography mask defects. Col. 6, lines 28-29. Col. 2, lines 28-37 describe Figs. 1(a)-(f). Figs. 2(a)-(b) illustrate an optical proximity corrected photolithography mask with typical defects. Col. 6, lines 30-31. Col. 2, lines 38-44 describe Figs. 2(a)-(b). Fig. 3 illustrates, in flowchart form, a typical method used to inspect photolithography masks for defects. Col. 6, lines 32-34. Col. 2, line 58 to col. 3, line 18 describes Fig. 3. Fig. 10(a) illustrates an example of how a potential mask defect can affect the process window of the photolithography process. Col. 6, lines 59-61. Col. 20, lines 14-31 describe Fig. 10(a).

Because Pang fails to disclose or suggest the recited limitations, Applicants request reconsideration and withdrawal of the rejection of Claim 1.

Claims 2, 3, 5, and 6 depend from Claim 1 and therefore are patentable for at least the same reasons as presented for Claim 1. Based on those reasons, Applicants request reconsideration and withdrawal of the objection to Claims 2, 3, 5, and 6.

Moreover, Claim 2 recites, "wherein computing includes determining a first critical dimension of the first feature and a second critical dimension of the second feature". The figure/passage cited in the Office Action to reject Claim 2 (i.e. Fig. 19 and column 24, line 47 to col. 25, line 6) fails to disclose or suggest this limitation. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 2.

Moreover, Claim 3 recites, "wherein computing includes calculating a relative critical dimension deviation for the first and second features". The figure/passage cited in the Office Action to reject Claim 3 (i.e. Fig. 10 and column 20, lines 33-50) fails to disclose or suggest this limitation. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 3.

Moreover, Claim 5 recites,

- identifying a first plurality of features proximate to the defect on the simulated wafer image of the physical mask;

- identifying a second plurality of features on the simulated wafer image of the reference mask, the second plurality of features corresponding to the first plurality of features; and

- calculating a plurality of relative critical dimension deviations for the first and second plurality of features.

The figure/passage cited in the Office Action to reject Claim 5 (i.e. Fig. 19 and col. 24, line 47 to col. 25, line 6) fails to disclose or suggest these limitations. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 5.

Moreover, Claim 6 recites, "determining the largest of the plurality of relative critical dimension deviations, thereby providing a maximum critical dimension deviation". The figure/passage cited in the Office Action to reject Claim 6

(i.e. Fig. 19 and col. 24, line 47 to col. 25, line 6) fails to disclose or suggest this limitation. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 6.

Claim 18 recites in part,

computing a first critical dimension deviation for a defect-free area of the physical mask using the simulated wafer images of the physical and reference masks;

computing a second critical dimension deviation for a defect area of the physical mask using the simulated wafer images of the physical and reference masks; and

using the first and second critical dimension deviations to provide the printability analysis.

The figure/passage cited in the Office Action to reject Claim 18 (i.e. see rejection of Claim 1 and col. 24, line 47 to col. 25, line 6) fails to disclose or suggest these limitations. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 18.

Claims 19, 20, and 21 depend from Claim 18 and therefore are patentable for at least the same reasons as presented for Claim 18. Based on those reasons, Applicants request reconsideration and withdrawal of the objection to Claims 19, 20, and 21.

Moreover, Claim 19 recites, "determining a tolerance for critical dimension changes". The figure/passage cited in the Office Action to reject Claim 19 (i.e. Figs. 1 and 2 as well as col. 2, line 58 to col. 3, line 17) fails to disclose or suggest this limitation. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 19.

Moreover, Claim 20 recites, "using the tolerance for critical dimension changes to provide the printability analysis". The figure/passage cited in the Office Action to

reject Claim 20 (i.e. Fig. 18 and col. 24, lines 36-45) fails to disclose or suggest this limitation. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 20.

Moreover, Claim 21 recites, "wherein using includes determining the number of exposures analyzed". The passage cited in the Office Action to reject Claim 21 (i.e. col. 17, lines 8-22) fails to disclose or suggest this limitation. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 21.

Claim 28 recites,

providing two-dimensional analysis on the defect and a first feature on the mask, the first feature being proximate to the defect;

providing a first wafer image of the mask;
and

providing defect analysis on a second feature on the wafer image, the second feature corresponding to the first feature being simulated, wherein providing defect analysis includes computing various critical dimension deviations based on the first and second features.

The Office Action rejects this claim based on the same figure/passage used for Claim 1. Because the cited figure/passage fails to disclose or suggest these limitations, Applicants request reconsideration and withdrawal of the rejection of Claim 28.

Claim 44 recites a physical mask comprising,

at least one defect being modified based on a first average critical dimension deviation and a first maximum critical dimension deviation provided from analyzing a simulated wafer image of the physical mask and a simulated wafer image of a reference mask, the reference mask corresponding to a defect-free physical mask.

The figure/passage cited in the Office Action to reject Claim 44 (i.e. Figs.9 and 19 as well as col. 24, line 47 to col. 25, line 6 and col. 18, lines 46-64) fails to disclose or suggest these limitations. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 44.

Claim 45 recites a physical mask comprising,

at least one irregularity being modified based on a first average critical dimension deviation and a first maximum critical dimension deviation provided from analyzing a simulated wafer image of the physical mask and a simulated wafer image of a reference mask, the reference mask corresponding to a defect-free physical mask.

The Office Action rejects this claim based on the same figures/passages used for Claims 1, 44, and 46. Because the cited figures/passages fail to disclose or suggest these limitations, Applicants request reconsideration and withdrawal of the rejection of Claim 45.

Claim 46 recites a physical mask comprising,

at least one feature being modified based on a first average critical dimension deviation and a first maximum critical dimension deviation provided by comparing a simulated wafer image of the physical mask and a simulated wafer image of a reference mask, the reference mask corresponding to a defect-free physical mask.

The figure/passage cited in the Office Action to reject Claim 46 (i.e. claim 44, Fig.17, and col. 23, line 64 to col. 24, line 21 fails to disclose or suggest these limitations. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 46.

Claim 47 recites an integrated circuit fabricated using a physical mask comprising,

at least one feature being modified based on a first average critical dimension deviation and a first maximum critical dimension deviation provided by comparing a simulated wafer image of the physical mask and a simulated wafer image of a reference mask, the reference mask corresponding to a defect-free physical mask.

The Office Action rejects this claim based on the same figures/passages used for Claims 1, 44, and 46. Because the cited figures/passages fail to disclose or suggest these limitations, Applicants request reconsideration and withdrawal of the rejection of Claim 47.

Claim 59 recites a physical mask comprising,

at least one defect being unmodified based on a first average critical dimension deviation and a first maximum critical dimension deviation provided from analyzing a simulated wafer image of the physical mask and a simulated wafer image of the reference mask, the reference mask corresponding to a defect-free physical mask.

The figure/passage cited in the Office Action to reject Claim 59 (i.e. Figs. 9 and 19 as well as col. 24, line 47 to col. 25, line 6 and col. 18, lines 46-64) fails to disclose or suggest these limitations. Therefore, Applicants request further reconsideration and withdrawal of the rejection of Claim 59.

The Office Action indicates that Claims 59-70 recite similar limitations as Claims 1, 44, and 46 and therefore are similarly analyzed. Applicants respectfully submit that the figures/passages cited in the Office Action to reject Claims 1, 44, and 46 fail to disclose or suggest the limitations of Claims 60-70. Therefore, Applicants request reconsideration and withdrawal of the rejection of Claims 60-70.

Applicant Addresses The 35 U.S.C. 103(a) Rejection

The Office Action admits that Claim 4 does not teach "subtracting the second critical dimension from the first critical dimension, and dividing a resulting value by the second critical dimension". The Office Action states this computation would be obvious and further states that Applicants have not disclosed that this computation provides an advantage, is used for a particular purpose, or solves a stated problem. Applicants respectfully traverse the rejection and the characterization.

Specifically, Applicants teach that a mask inspection system and process that provides an objective, accurate measure of mask defect printability and mask quality is needed. Specification [0015]. Applicants further teach that defect analysis includes determining a relative CD deviation (RCD). Specification [0024].

Referring to the Specification [0025], to calculate the RCD, a CD of an identified neighbor feature on the simulated wafer image of the reference mask is subtracted from the CD of the corresponding feature on the simulated wafer image of the physical mask. Note that a feature can be one-dimensional, such as a line or space, or two-dimensional, such as a contact hole, pile, post, serif, or some other area-based structure. This difference is then divided by the CD of the corresponding feature on the simulated wafer image of the reference mask. In one embodiment, the RCD can be calculated for each neighbor feature and for each exposure. The maximum CD deviation (MCD) among the RCDs can then be determined for each exposure level.

The MCDs can be used to compute the defect severity score (DSS). Specification [0027]. Applicants respectfully submit that the DSS can provide an objective, accurate measure of mask defect printability and mask quality. For example, as taught by Applicants in the Specification [0028], the defect printability

analysis generator could output a DSS having a scale from 1 to 10 in an impact report. This impact report can be used to reduce human error in defect printability analysis. For example, perhaps a predetermined DSS score could indicate that the printed features (as simulated by the inspection system) would have significant performance issues, but that repair of the physical mask is possible. On the other hand, perhaps a higher DSS score than above could indicate not only performance issues, but that re-fabrication of the physical mask is recommended. Thus, by providing a numerical result having an associated meaning for each number, a technician can proceed efficiently and without error to the next action, e.g. repair of the physical mask or re-fabrication of the physical mask.

Applicants note that Claim 4 depends from Claim 3, which in turn depends from Claim 2, which in turn depends from Claim 1. Therefore, for example, the first critical dimension is associated with the first feature, which is proximate to the defect on the simulated wafer image of the physical mask. Moreover, the second critical dimension is associated with the second feature, which is on the simulated wafer image of the reference mask and corresponds to the first feature. Applicants respectfully submit that calculating the relative critical dimension deviation including first and second critical dimensions is neither disclosed nor suggested by the cited reference. Thus, this computation is not obvious as characterized in the Office Action.

Applicants note that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made.

CONCLUSION

Claims 1-70 are pending in the present application.
Allowance of these claims is respectfully requested.

If there are any questions, please telephone the
undersigned at 408-451-5907 to expedite prosecution of this
case.

Respectfully submitted,



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Service as FIRST CLASS MAIL in an envelope addressed to: Commissioner for Patents, P.O.
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